CANDIDATE'S NUMBER

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Physics 30
Supp. 1966

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DEPARTMENT
EDUCATION ALBERTA

HIGH SCHOOL AND UNIVERSITY MATRICULATION
EXAMINATIONS BOARD

DEPARTMENTAL EXAMINATIONS, 1966
SUPPLEMENTAL

PHYSICS 30

Time — 3 hours.

Total Possible Mark — 150.

DO NOT SPEND TOO MUCH TIME ON ANY ONE QUESTION.
READ THE QUESTIONS CAREFULLY.

Mathematical tables, slide rules and geometry sets may be used.

Complete solutions must be shown for all problems.

Rough and finished work may be done in pencil or ink (Blue or Black).

DO NOT FOLD THIS BOOKLET.

Place your test booklet in the answer envelope in such a way that the UPPER LEFT HAND CORNER OF THE BOOKLET (Candidate's Number) shows through the SLASHED CORNER of the answer envelope.

BE SURE TO SEAL THE ENVELOPE.

Constants:

$g = 980$ cm/sec^2 or 32 ft/sec^2

$J = 778$ ft lb wt BTU or 4.2 joules per cal.

One horsepower = 550 ft lb wt sec or 746 watts

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CURR HIST

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ROUGH WORK ONLY

(No marks given for work in this space)

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Values

3 **1.** A bus makes a 300 mile trip. For the first 150 miles it averages 50 mph. For the next 150 miles it travels fast enough so that the average speed for the whole distance is 60 mph. What is the average speed during the second 150 miles of the trip?

2. An airplane is moving through calm air at 120 mph due north. It encounters a west wind of 50 mph.

2 (a) What is its speed now relative to the ground?

2 (b) What is its direction now?

ROUGH WORK ONLY

(No marks given for work in this space)

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Values

3. A car of mass 4000 lb is accelerated at the rate of 12 ft/sec/sec.

2 (a) What distance would it travel from rest to attain a speed of 45 mph?

2 (b) What net force caused this acceleration?

2 (c) How many seconds does it take to attain this speed?

2 (d) At 45 mph the kinetic energy of this car is 2¼ times as great as it was at another speed. What was the other speed?

4. A motor delivering 16 hp is used to lift an elevator of mass 2200 lb a distance of 60 ft at constant speed.

2 (a) What is the work done on the elevator?

2 (b) How long will it take the elevator to make the ascent?

ROUGH WORK ONLY

(No marks given for work in this space)

Values

4 **5.** A stone is thrown horizontally with a velocity of 12 ft/sec from the top of a building. It lands a distance of 45 ft from the base of the building. What is the height of the building?

4 **6.** A stone is thrown upwards from the top of a building 512 ft high. It strikes the ground near the base of the building 8.0 sec later. What was the vertical velocity of the stone when it left the top of the building?

ROUGH WORK ONLY

(No marks given for work in this space)

Values

7. A stone weighing 75 lb is suspended at a height of 36 ft above the ground.

2 (a) What is the potential energy of the stone?

2 (b) What is its velocity just before it strikes the ground?

2 (c) If all its kinetic energy is turned into heat energy when it hits the ground how many B.T.U.'s of heat are developed?

3 **8.** What is the length in feet, of a pendulum which has a period of vibration of 2.5 seconds? (Use $\pi^2 = 10$)

2 **9.** A pendulum clock is moved from a coastal area to a high altitude area. What would happen to its accuracy of keeping time? Explain.

[OVER]

ROUGH WORK ONLY

(No marks given for work in this space)

Values

4 **10.** A car of mass 4500 lb and travelling 36 ft/sec overtakes and collides with a car travelling 20 ft/sec in the same direction. The cars travel on together as a unit at 30 ft/sec. What was the mass of the smaller car?

4 **11.** A block of material of mass 125 lb is held against a vertical plane by a force of 40 lb wt exerted horizontally. If the coefficient of friction is 0.15 find the vertical force which must be applied to the material to move it up the plane at constant speed.

4 **12.** How many kilograms can a machine supplying 196 watts of power lift through a distance of 10 meters in 45 sec.?

[OVER]

ROUGH WORK ONLY

(No marks given for work in this space)

Values

6 **13.** A picture of mass 10 lb is held in a horizontal position by a wire over a nail. The angle in the wire at the nail is 120°. What is the tension in the wire? (A scale diagram may be used.)

4 **14.** A piece of aluminum is attached to a piece of wood so that the combined mass floats in water without any part of the mass above water. The aluminum weighs 54 gm wt and has a density of 2.7 gm/cc. The wood weighs 51 gm wt. What is the specific gravity of the wood?

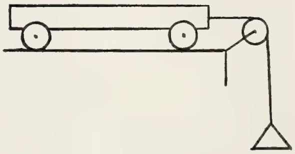
ROUGH WORK ONLY

(No marks given for work in this space)

Values

3 **15.** A uniform meter stick of mass 50 gm has a 45 gm wt suspended from it at the 30 cm mark and a 65 gm wt suspended from the 70 cm mark. Where is the center of gravity of the whole system?

16. A trolley whose mass is 14 lb is pulled along a horizontal plane by a 2.0 lb wt as shown in the diagram.



3 (a) What is the acceleration of the system?

3 (b) What is the tension in the string?

ROUGH WORK ONLY

(No marks given for work in this space)

Values

2 **17.** The volume of a liquid in a container at 5.0° C is 60.5 cc. When heated to 90.0° C the apparent volume in the same container is 63.0 cc. What is the apparent coefficient of volume expansion of the liquid in this container?

3 **18.** The coefficient of real volume expansion of a certain liquid is 1.8×10^{-4}/C°. The coefficient of linear expansion of glass is 8.0×10^{-6}/C°. Calculate the coefficient of apparent volume expansion for this liquid in glass.

4 **19.** A dilatometer bulb contains 0.020 liters of mercury which extends into the tube at 0° C. How far will the mercury rise in the tube when the temperature is raised to 100° C if the cross sectional area of the uniform bore is 0.80 sq mm? The coefficient of apparent volume expansion of mercury in glass is 1.5×10^{-4}/C°.

ROUGH WORK ONLY

(No marks given for work in this space)

Values

2 **20.** Find the water equivalent of a copper calorimeter of mass 100 gm if the thermal capacity of 200 gm of copper is 20 cal.

3 **21.** A metal block of mass 300 gm is raised to a temperature of 100° C. and then placed in a calorimeter containing 350 gm of water at 10° C. The final temperature of the mixture is 25° C. Find the specific heat of the metal. The water equivalent of the calorimeter is 25 gm.

5 **22.** Find the change in temperature of 6.0 kg of water at 20° C when it is poured into 2.5 kg of molten lead at its melting point of 327° C. The specific heat of lead is 0.030 and the heat of fusion for lead is 5.4 cal/gm.

[OVER]

ROUGH WORK ONLY

(No marks given for work in this space)

Values

6 **23.** A copper drum of circumference 60 cm and mass 300 gm contains 150 gm of water. A silk band loaded with a weight of 3000 gm passes over the drum's surface and when the drum is driven at 180 rev/min the reading on the spring balance, which is attached to the other end of the silk band, is 600 gm. Calculate the mechanical equivalent of heat if the temperature of the water rises 36 C° after 10 min. The specific heat of copper is 0.10.

6 **24.** The boilers and steam turbines of a power plant deliver 1.05×10^4 kw while using 10^5 cu ft of natural gas in an hour. Find the efficiency of the power plant if one cu ft of gas gives 2.5×10^5 cal. The mechanical equivalent of heat is 4.2 joules/cal.

ROUGH WORK ONLY

(No marks given for work in this space)

Values

25. Two points, A and B, differ in potential by 750 esu of potential.

3 (a) How much work is done against the electric field in bringing a charge of +20 esu from one point to the other?

1 (b) Toward what point is the charge moved if A has a higher potential than B?

26. Two small identical metal spheres have charges of +50 and –40 esu respectively.

3 (a) What is the force acting between them if they are 10 cm apart in a fluid of dielectric constant 5.0?

2 (b) If the spheres are touched together and then separated 10 cm in the same fluid, what is the force between them?

2 (c) Indicate if the force is one of attraction or repulsion in each of the above cases.

ROUGH WORK ONLY

(No marks given for work in this space)

Values

27. A current of 10 amp flowing through a voltameter causes the weight of the cathode to increase by 2.04 gm in 10 min.

2 (a) Calculate the electrochemical equivalent of the metal that is deposited on the cathode.

3 (b) Find the atomic weight of the metal if its valence is 2. One faraday = 96,500 coulombs.

28. The moving coil of a galvanometer has a resistance of 20 ohms and gives a full-scale deflection when the current in it is 0.050 amp.

2 (a) Calculate the resistance needed to make the galvanometer into a 5.0-volt meter.

2 (b) Calculate the resistance needed to make it into a 1.0-amp meter.

2 (c) How much current will be flowing through the coil in the 1.0-amp meter when the line current in the circuit is 0.20 amp?

[OVER]

ROUGH WORK ONLY

(No marks given for work in this space)

Values

3 **29.** Calculate the resistance of 1.5 km of wire which has a cross sectional area of 0.30 sq mm. The specific resistance of the metal is 1.5×10^{-6} ohm-cm.

4 **30.** A cell is connected across a resistance of 4.5 ohms, and the potential difference across the resistance is 1.35 volts. When the resistance is replaced by one of 7.0 ohms the potential difference is 1.4 volts. Find the E.M.F. and internal resistance of the cell.

ROUGH WORK ONLY

(No marks given for work in this space)

Values

31. Three resistances of 2.0, 3.0 and 6.0 ohms, respectively are connected in parallel. This bank of resistances is in series with a battery of internal resistance 1.0 ohm and another resistance of 4.0 ohms. The E.M.F. of the battery is 12 volts.

2 (a) What is the current in the battery?

2 (b) What is the difference of potential across the 4.0 ohm resistor?

2 (c) What is the difference of potential across the 2.0 ohm resistor?

2 (d) What is the current in the 3.0 ohm resistor?

2 (e) What is the current in the 6.0 ohm resistor?

2 (f) If another battery with the same internal resistance and E.M.F. as the original battery is connected in parallel with it, what will be the current in the 4.0 ohm resistor?

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Values

2 **32.** How is the E.M.F. induced in a moving conductor affected when the speed of the conductor is doubled?

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2 **33.** How is energy transferred from the primary coil to the secondary coil of a transformer?

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34. An electric iron which is rated at 1000 watts is connected to a 110 volt line.

3 (a) How many calories of heat are produced each hour?

2 (b) How much does it cost to do the week's ironing if it takes 3.5 hr at 4.0¢/kw-hr?